Eastern Region
Winter Weather Best Practices Team Report

November 5, 2001

I. Introduction

A best practices team was assembled in June of 2001 to document winter weather forecast strategies and tactics employed by highly successful Eastern Region Weather Forecast Offices (WFOs).

From the outset, the team recognized that many variables determine a successful winter weather program from a customer/ partner standpoint. However, the team only considered internal NWS operational elements of the winter weather program.

The team used winter warning verification statistics to diagnose the strategic problem (Section II) and develop tactics to mitigate it (Section III). It should be noted that the team recognizes that performance metrics alone do not reflect the quality or success of an office's winter weather program.

II. Strategic Problem

The strategic problem is to maximize both the Critical Success Index (CSI) and Lead Time (LT) in a way that optimizes winter warning service to customers.

A) CSI Maximization

An analysis of historical verification statistics (attachment 3) indicated that the False Alarm Ratio (FAR) has the greatest impact on CSI scores. Thus it appears that any training, decision making or verification efforts focused on reducing FARs will have the largest positive impact on improving CSIs.

B) Lead Time Maximization

Lead times must be long enough for users to prepare for a storm, but not so long as to adversely impact CSI scores, which tend to fall off with longer LT (attachment 4). Setting a LT that is adequate for local emergency response and ecovery teams, yet short enough to keep CSIs high, is a difficult task. Each WFO must work independently with users to establish a desired LT.

III. Tactical Solutions

A) FAR Reduction Methods

1) Training/Research

a Prior to each winter season, each forecaster should review local snowfall climatology and past office verification scores;

b) Prior to each winter season, offices with a CSI or LT below the previous season's regional average must discuss the main causes, determine solutions, and develop a local operational plan with explicit goals, to train forecasters;

c) Hold seminars to review model biases and emphasize topographic and other local effects;

d) Place <u>scientifically sound</u> forecast aids, local studies, training material and the latest policy rules (warning criteria) on the LAN, for instant reference at the forecast desk;

e) Develop and implement a **seasonal familiarization plan for winter weather** that emphasizes the accurate prediction of precipitation types (PTYPE)and quantitative precipitation forecasts (QPF). Seasonal familiarization should be completed by each forecaster in a timely manner prior to the onset of winter weather. Components of the plan may include local research efforts, COMET modules, proficiency drills, tele-training lessons, web-based materials, etc.;

f) When training materials do not adequately address local forecast problems, local research projects should be established to fill this need.

g) For links to web-based training materials, go to:

http://www.werh.noaa.gov/MSD/bestpractice/winter/bgm/wintertopgun.htm

2) Warning Decision Making

a) Staffing
   1) Make sure enough people are on shift when watch/warning decisions are made, to shelter the decision maker(s) from interruptions;
   2) schedule experienced forecasters with less experienced ones on shift together;
   3) key on people's strengths for on-shift assignments;

b) Check model reality with observations;

c) Use a consensus forecasting approach within surrounding WFOs, and within your own;

d) Establish local AWIPS procedures to assist forecasters in diagnosing:
   1) PTYPE (especially using the Bourgouin method),
   2) QPF,
   3) Precipitation Efficiency Microphysics,
   4) Frontogenetic zones, and
   5) Low level jets (for moisture transport);

e) **<u>Key on model signals, not model solutions</u>** to target threat areas. Threat areas that overlap from model run to model run (or from multiple models at the same run time and/or ensembles) should be the primary target areas. Then work outward from the primary target area to carefully select additionalzones for watch and warning areas;

f) Give more weight to prognostic fields that are conservative in space and time, such as heights or thickness, to reduce the targeted threat area. Derived fields, which depend on parameterization schemes (such as QPF), are prone to run-to-run inconsistencies, and

g) Identify and use the climatological liquid-to-snow ratios as a first guess for snowfall based on QPF, then adjust upward or downward based on (atypical)temperature regimes.

3) Verification

a) Tabulate, plot and record seasonal verification statistics **on a ZONE BY ZONE basis**; **note trouble spots (particularly high FAR areas) and share with the staff** to improve service to those areas;

b) Increase the number of winter weather spotters in high FAR areas by training advanced severe weather spotters on snowfall measurement in the autumn;

c) Expand use of alternative observation sources such as DOT, airport maintenance, media, Internet Webcam Sensors, etc.;

d) Facilitate submission of observations to the WFO via the Internet (using CGI scripts);

e) Within one week after each storm, generate rapid verification feedback to forecasters, so they can quickly calibrate their performance. Graphical representations of forecast snowfall minus observed snowfall amounts should be viewed when available.

B) Lead Time Maximization

a) Discuss with users what they consider to be adequate advance notice for their operations, then tune NWS operations to slightly exceed the requirements of the majority;

b) Avoid excessive lead time for watches and warnings to minimize media hype and raise CSIs. Fourth period watches and third period warnings should only be issued when confidence is very high or a long weekend or holiday notification is needed, and

c) Be sure to compute WFO seasonal average lead time using a <u>weighted average</u> of each storm's lead time. For example, an office with two storms might have:

((20 zones x 12 hr LT) + (36 zones x 16 hr LT))/56

yielding the correct LT of 14.57 hrs, rather than (12 hrs + 16 hrs)/2 which gives only 14 hours!

IV. Conclusion

The keys to improving winter weather service and verification scores in Eastern Region are to:

1) increase CSIs by reducing FARs, and
2) set desired LTs to optimize warning utility and skill.

FARs can be reduced through a series of training, warning decision and verification initiatives.

Lead Times for watches and warnings can be optimized by consulting with partners to determine how much advance notice they require, and then targeting operations to slightly exceed that mark.

Attachment 1 - Other Considerations

During the course of the Best Practices meeting, several additional points were made regarding optimizing performance, that the team considered noteworthy.

Storms expected to impact an area on a Sunday or Monday may require advance notice to emergency responders on Friday afternoon, to assure their vigilance over the weekend. Holidays may also require special advance notification.

Forecasters should be aware of local media broadcast times when issuing products. Forecasters should avoid focusing on extreme possibilities, and provide a consistent story to each media outlet.

Frequent Public Information Statements should be issued during events. Assisting the media in their job may reduce office phone workload.

Attachment 2 - Best Practices Checklist

A) Training - Pre-season Preparation	**Y**	**N**
1) Have all forecasters reviewed local snowfall climatology?	_____	_____
2) Have problem areas and goals been conveyed to all staff?	_____	_____
3) Has all staff attended seminars to review model biases/local effects?	_____	_____
4) Are sound forecast aids and policy available on the LAN?	_____	_____
5) Have all forecasters received recent winter weather training, including QPF, PTYPE and cloud microphysics?	_____	_____
6) If local forecast problems exist, and no training materials address them, is local research being done to solve them?	_____	_____

B) Warning Decision Making - Before the Storm	**Y**	**N**
1) Is adequate staffing available?	_____	_____
2) Do current observations match models?	_____	_____
3) Have surrounding WFOs been consulted and has consensus been achieved?	_____	_____
4) Are QPF, PTYPE, cloud microphysics, frontogenetic and low level jet procedures being used in AWIPS?	_____	_____
5) **Are model signals rather than solutions, being used to target the primary threat area?**	_____	_____
6) Are areas outside the primary threat area being judiciously added to the watch/warning area?	_____	_____
7) Will the rain/snow line form in, or traverse your CWA? Adjust snowfall accordingly!	_____	_____

B) Warning Decision Making - Before the Storm

8) Adjust snow amounts based on your knowledge of climatological snow to water equivalent ratios and storm environmental temperature!

C) Verification - After the Storm	**Y**	**N**
1) Compute verification statistics on a zone by zone basis.	_____	_____
2) Do high FAR areas have enough spotters?	_____	_____
3) Are alternative observation sources used? (DOT, airport maintenance, media, Webcams)	_____	_____
4) Are snow spotter reports collected via the Internet?	_____	_____
5) Is rapid verification feedback available for the forecasters? (It should be).	_____	_____

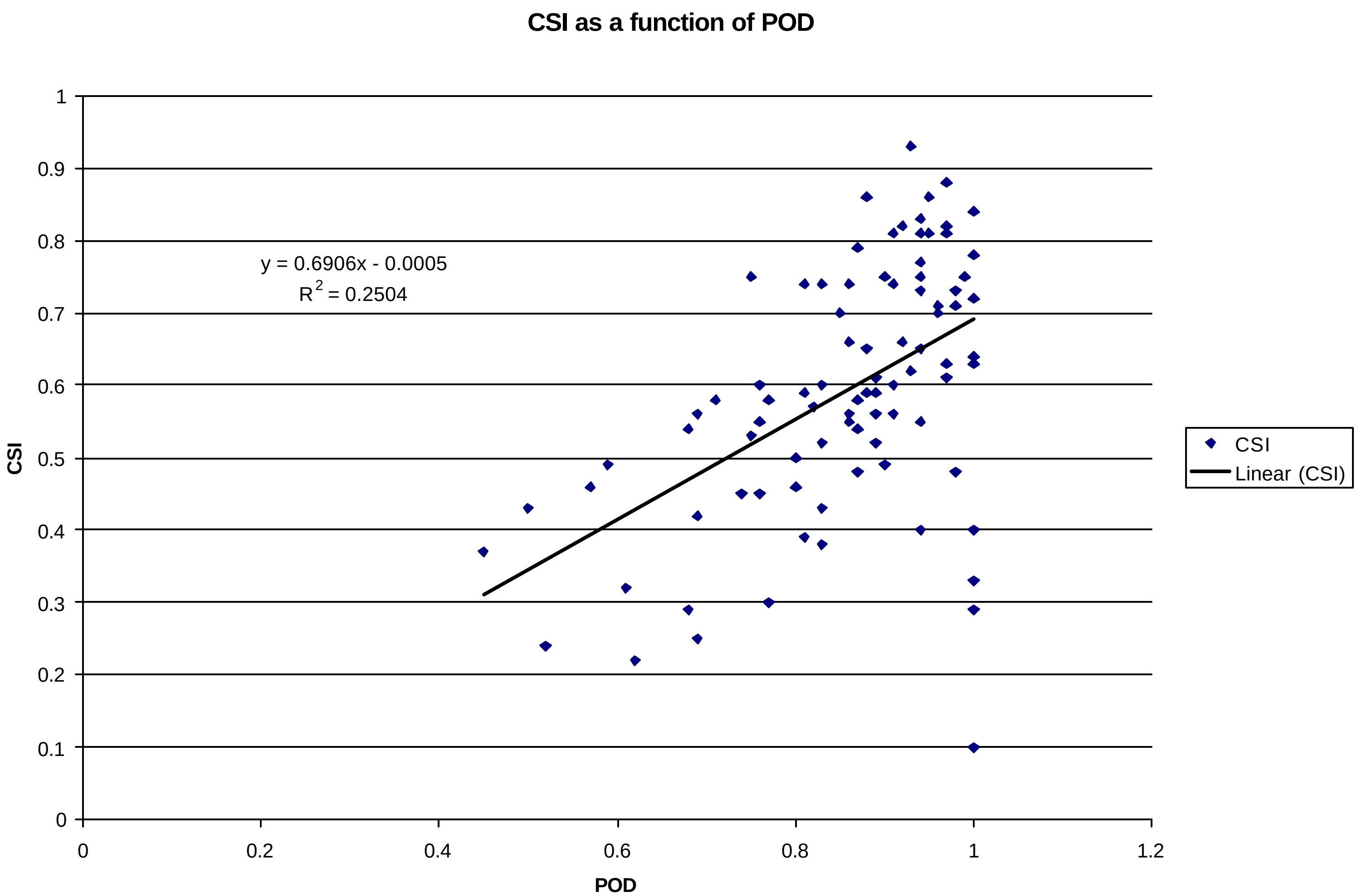
D) Lead Time Maximization

1) Were users contacted in the fall to find out what they consider adequate and optimum lead times for watches and warnings?	_____	_____
2) Are WFO seasonal average Lead Times computed using a weighted average of each storm’s LT?	_____	_____

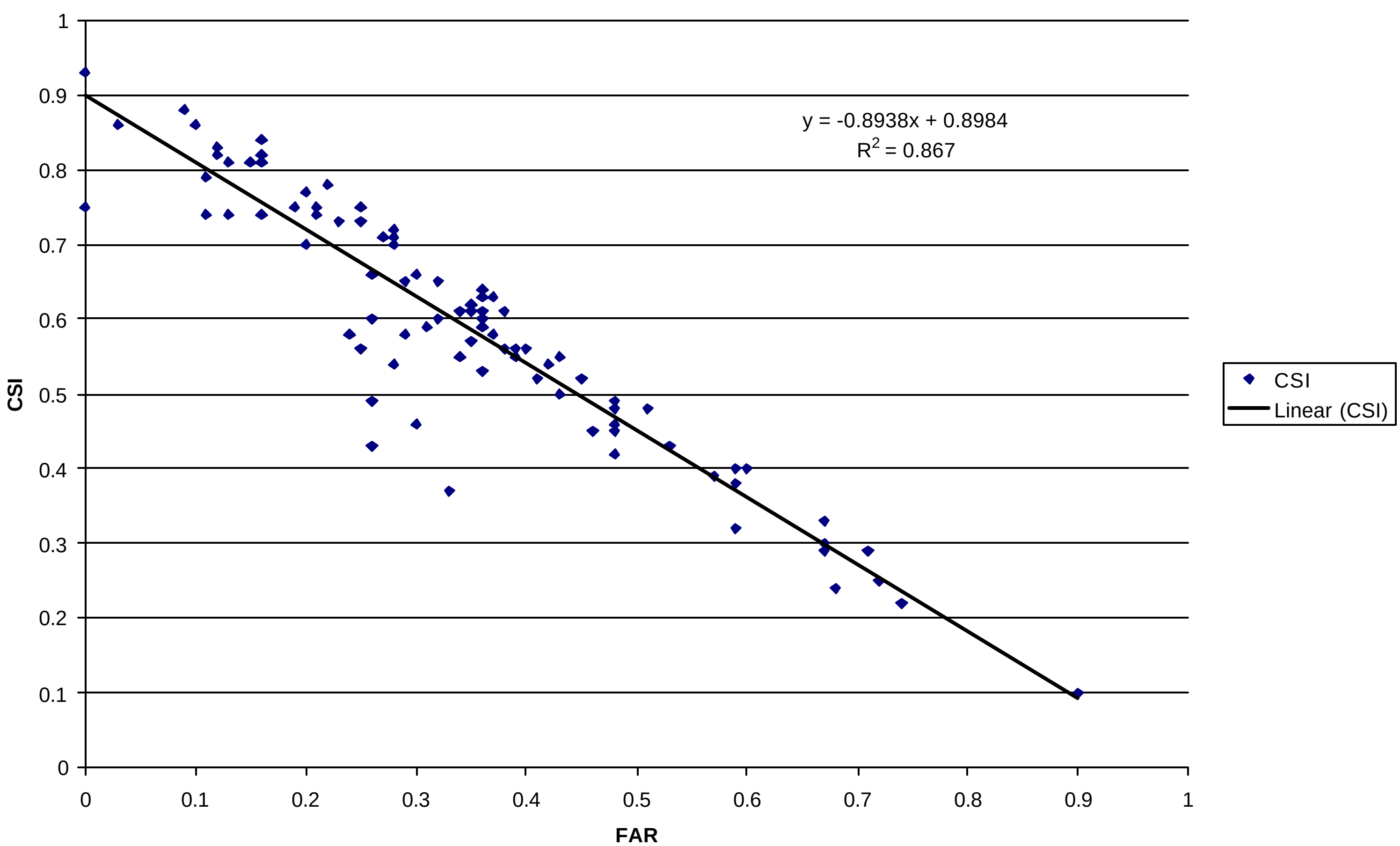
Attachment 3 - Analysis of Historical Verification Statistics

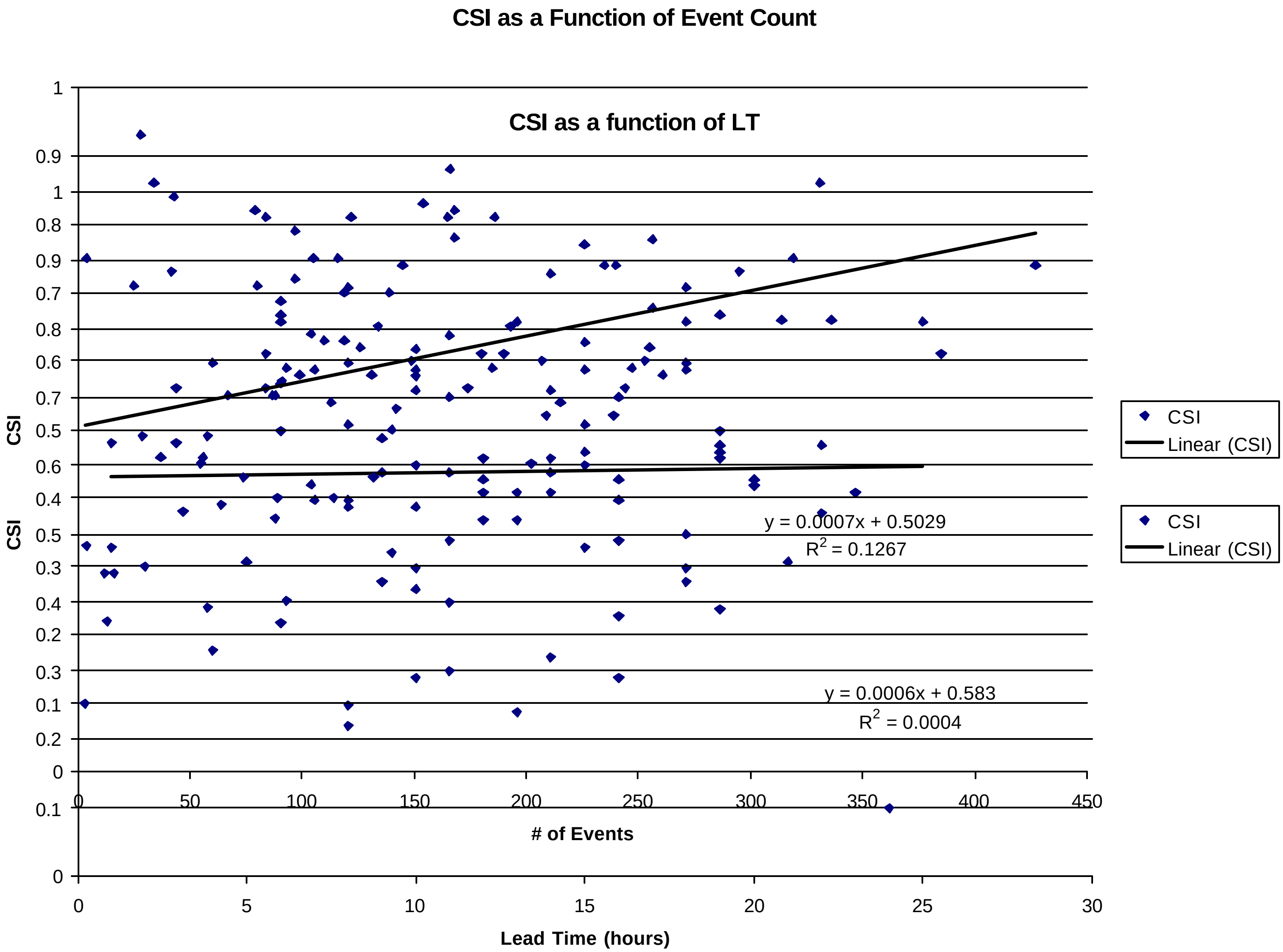
A correlation analysis of <u>winter **warning**</u> CSIs with respect to POD, FAR, LT and event count revealed that an office's warning CSI is most related to its FAR. The FAR accounts for over 85% of the linear variance in the CSI sample (see charts below).

The data used for this regional analysis came from the 12 original NWSFOs, for the period of 1994-95 to 2000-01 seasons.



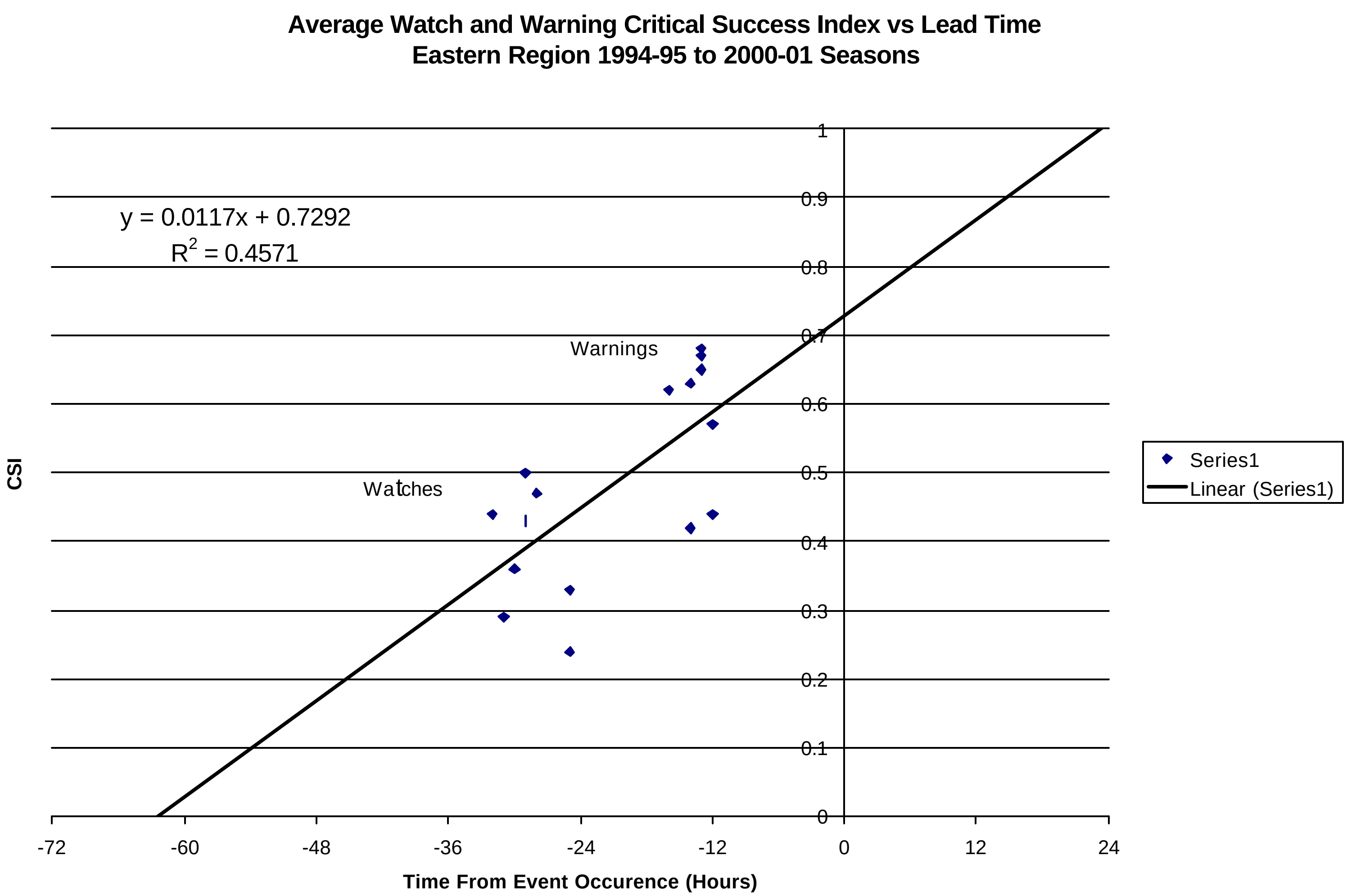
CSI as a function of FAR




CSI as a Function of Event Count
CSI as a function of LT
CSI
# of Events
Lead Time (hours)
CSI
Linear (CSI)
y = 0.0007x + 0.5029
R^2 = 0.1267
y = 0.0006x + 0.583
R^2 = 0.0004

Attachment 4 - Lead Time Optimization

A plot of **both** <u>watch</u> and <u>warning</u> CSIs vs LT from 1994 to 2001 for Eastern Region demonstrates that shorter LTs tend to yield higher CSIs. In fact, to generate a CSI of 1, not enough information is usually available until nearly 24 hours ***AFTER*** the



winter storm has occurred!

Conversely, CSIs drop to near zero at -62 hours [(i.e. 62 hours before the event occurs (see chart below)].

Team Members

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